ABSTRACT

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EVALUATION OF-MODE SHAPE EXPANSION TECHNIQUES ON THE MICRO-PRECISION INTERFEROMETER TRUSS

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Existing and new mode shape expansion methods are presented within the framework of least squares minimization techniques with quadratic inequality constraints (LSQI) [1], The general form of the LSQI problem is posed as:

$$\min_x \|Ax - b\|_2 \qquad subject\ to \quad \|Bx - d\|_2 \leq \alpha$$

Three alternative formulations for mode shape expansion are proposed. In the first, the optimal expanded mode shape x is the one that minimizes the total strain energy, subject to the constraint that the norm of the relative changes to the eigenvectors at the *measured* degrees-of-freedom (dofs) is less than or equal to a prescribed value, ct. In the second formulation, the constraint considers the relative change at the ***full set*** of dofs. In the third formulation, the dynamic residual force vector is minimized, with the same constraint as the first formulation.

When α approaches zero, it is shown that the first method reduces to a "Guyan" static expansion [2], and the second and third methods reduce to the "Kidder" dynamic expansion [3]. Previously developed methods using orthogonal projections [4] or unconstrained minimization [5] can also be formulated through LSQI.

All these techniques will be evaluated with the full set of experimental data obtained on the Micro-Precision Interferometer testbed [6], using both the pre-test and updated analytical models [7]. The robustness of these methods will be verified with respect to measurement noise, model deficiency, number of measured dofs and accelerometer location.

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